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A Structural Approach to Analogy

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Abstract

There are multiple sorts of reasoning by analogy between two domains; the one with which we are concerned is a type of contextual analogy. The purpose of this paper is to see whether two domains that look analogous would be analogous in all aspects and contexts. To perform this, we analyse the domain according to different particularities. For each particularity or context we continue the analysis and search for another one within the same domain. In this way we create a kind of structure for the different domains. This sort of analysis is represented by frames and frames which are nested within each other.

This paper describes this concept and an implemented system "MULTI-ANALOG", a limited example of knowledge-acquisition, problem solving, and automatic-acquisition based on this particular form of analogy namely structural analogy.

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1. Introduction

1.1. Key Idea

There are multiple types of reasoning by analogy. We are concerned here with the one which is applicable in some particular domains within which it is possible to determine clearly the different contexts and levels.

We will try to see how it is possible to reason by analogy in different contexts. The reason for this is to find out whether two domains that look analogous in some contexts would be analogous in all contexts?

1.2. Analysis of Domains

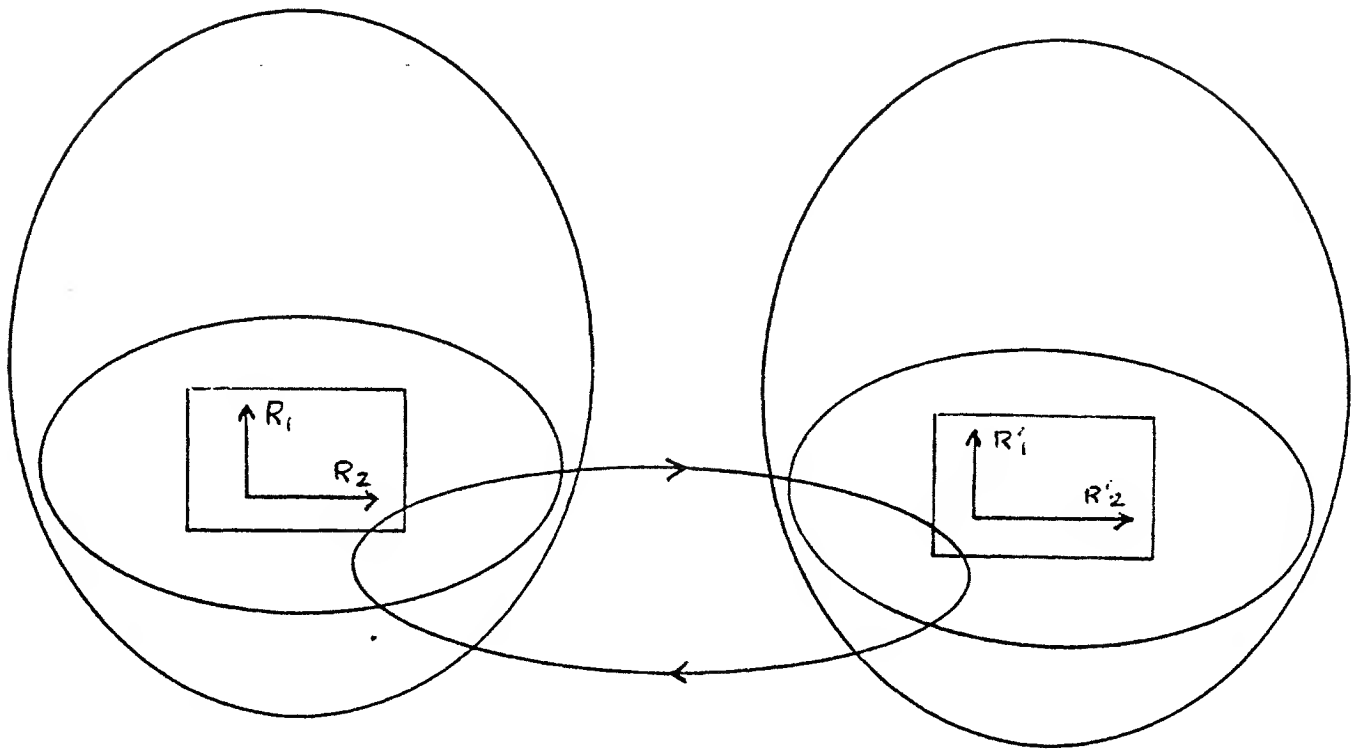
This leads us to consider, for a contextual approach, a whole series of levels for each domain composed of intrinsic elements and laws, creating a kind of structure.

Preceding to a form of analysis made up of different levels, an object or a domain could once be analogous to another one. In this way, a whole series of objects could be equal, within a context, to one another, and yet be totally different from each other in another context. Consequently, we can define an object or a domain, for a specific context by its elements and the laws which govern its elements.

A domain is contextually analogous to another, if at one precise moment in the analysis, there exists a similarity between it and another domain which is in the same state and context. In this way, we can observe that at one level of analysis an analogy exists between two domains. In going a bit further in the analysis, layers and sublayers could or could not be analogous to each other.

Therefore, we have a concept of analogy which is essentially based on structure. This means that when we study this sort of reasoning, we must be aware of both the level and the context.

Concept of Structure in an Analogy



2. System

2.1. Systems Implemented in this Particular Example of Knowledge-Acquisition and Problem-Solving

A system was implemented, "MULTI-ANALOG", whose details show us the manner in which we conceive the following:

- * Frames, as the initial representation of knowledge; the matching concept.
- * A particular form of knowledge-acquisition, problem solving and automatic-acquisition ; frames as the final representation of knowledge.

In the following pages, we will describe the concepts of the two sections presented above, as well as summarize the implementation of these concepts. Here, a closer look at the concepts and implementation will offer a clearer explanation of the learning and problem solving aspects based on the structural analysis described in the previous chapter.

2.2. Frames, as the Initial Representation of Knowledge; the Matching Concept

The European countries were chosen as subjects to be processed in frame-like form. We chose several European countries with parameters such as *capital*, *religion*, *political system* and subdivisions of each of these parameters to better illustrate the concept of structural analysis in an analogy.

In implementation, two distinct representations of frames were used.

2.2.1. First Form of Frame Representation

A first form of frames representing England and France with slots such as *capital*, *religion* and *political system* shown in the following manner:

for England

```
(f england)
(ENGLAND (AKO (COUNTRY))
  (CAPITAL (LONDON))
  (RELIGION (PROTESTANT))
  (POLITICAL-SYSTEM (AKO-DEMOCRACY)
    (EUROPEAN-ECONOMIC-TREATY (COMMON-MARKET)
      (EUROPEAN-MILITARY-TREATY (NATO))
      (POSITION-SECOND-WORLD-WAR (ALLIED))))
```

AKO means A-KIND-OF

and for France

```
(f france)
(FRANCE (AKO (COUNTRY))
  (CAPITAL (PARIS))
  (RELIGION (CATHOLIC))
  (POLITICAL-SYSTEM (SOCIALISM))
  (EUROPEAN-ECONOMIC-TREATY (COMMON-MARKET)
    (EUROPEAN-MILITARY-TREATY (NEUTER)
      (POSITION-SECOND-WORLD-WAR (ALLIED))))
```

This allows the achievement by an appropriate heuristic of the first level of structural identification. This heuristic consists of a correspondence between a "goal" directly input on the keyboard, and the value slots which are a part of each of the two frames containing the respective knowledge about each domain for that specific goal.

Existence or the lack of existence of a correspondence causes a message sending and, as we will see later, the generation of the appropriate frames, as follows:

(simple-analog 'france 'england)

*** Goal ?

religion

*** RELIGION of FRANCE is CATHOLIC but RELIGION of ENGLAND is PROTESTANT..therefore no analogy of RELIGION between FRANCE and ENGLAND.

With this first form of knowledge representation, we only touch upon one level of analogy.

Therefore, when we try to see if there is any analogy between France and England, the system asks for which goal, reason or meaning we are looking. In this case, we used *religion*, however, the reason or goal could have been any other value slot such as *capital* or *political system*, etc.

With this type of frame representation our goal or analysis stops at one level, which means that we can go no further.

Our knowledge about *religion* stops here- Protestant for England, and Catholic for France; and for *political system*- socialism for France, and ako-democracy for England. This means that we can not learn any more about protestantism, catholicism, democracy nor socialism.

2.2.2. Second Form of Frame Representation- Nested Frame and Semantic-Network

A second form of representation of the countries, England and France, was chosen in the form of "nested frames" which represente the appropriate Semantic Network on three levels. This means that the slot of the first frame becomes a new frame, and the slot of the new frame becomes another new frame.

These frames nested on three levels permit us to analyze a domain within three successive shells, as follows:

for England

(f england)

```
(ENGLAND (CAPITAL (LONDON))
          (POLITICAL-SYSTEM (AKO-DEMOCRACY))
          (RELIGION (PROTESTANTISM))
          (MUSEUM (BRITISH-MUSEUM))
          (UNIVERSITY (IMPERIAL-COLLEGE)))
```

Each value slot such as *ako-democracy* becomes, itself, a new frame as follows:

```
(f ako-DEMOCRACY)
(ako-DEMOCRACY (EDUCATIONAL-SYSTEM (CONSTITUTIONAL-RIGHTS))
               (MILITARY-SYSTEM (ALIGNED))
               (MEDICAL-SYSTEM (NATIONAL-HEALTH)))
```

Again, each value slot such as *National Health* becomes a new frame , as follows :

```
(f National-Health)
(National-Health (Aspect-of-Health (Free-Health-Care)))
```

and for religion it becomes:

```
(f protestantism)
(PROTESTANTISM (BELIEVING SYSTEM (MONOTHEISM)))
```

and for France

```
(f france)
(FRANCE (CAPITAL (PARIS))
        (POLITICAL-SYSTEM (SOCIALISM))
        (RELIGION (CATHOLICISM))
        (MUSEUM (RODIN))
        (UNIVERSITY (PARIS-ORSAY)))
```

Each value slot such as *socialism* becomes itself, a new frame as follows;

```
(f socialism)
(SOCIALISM(EDUCATIONAL-SYSTEM (PUBLIC-EDUCATION))
          (MILITARY-SYSTEM (INDEPENDENT))
          (MEDICAL-SYSTEM (PUBLIC-HEALTH)))
```


Again, each value slot such as *public-health* becomes a new frame, as follows:

```
(f public-health)
(PUBLIC-HEALTH (ASPECT-OF-HEALTH (FREE-HEALTH-CARE)))
```

For *religion* it becomes:

```
(f catholicism)
(CATHOLICISM (BELIEVING-SYSTEM (MONOTHEISM)))
```

Again, each value slot such as *monotheism* becomes a new frame, as follows:

```
(f monotheism)
(MONOTHEISM (ASPECT-OF MONOTHEISM (UNIQUENESS-OF-GOD)))
```

Such a representation allows us to reach, by an appropriate heuristic, three levels of structural identification.

This heuristic consists of finding a correspondence on each of three levels of analysis between the meaning, reason or goal of the analogy directly input on the keyboard and the value slots of the "nested frames", representing each of the two domains in the form of Semantic Network (cf. page 12 and 13). Existence or the lack of existence of a respective correspondence on each of the three levels of analysis between the two domains causes the message sending and, as we will see later, the generation of the appropriate frames corresponding to each level, as follows:

```
(compound-analog 'france 'england)
```

```
*** Beginning of analysis first-level-analysis ?
```

```
religion
```

```
*** Religion of FRANCE is CATHOLICISM ....
```

```
and RELIGION of ENGLAND is PROTESTANTISM....
```

```
therefore no analogy of RELIGION between FRANCE and ENGLAND.
```

```
*** Suite of analysis second-level-analysis ?
```

```
believing-system
```

```
*** BELIEVING-SYSTEM of FRANCE is MONOTHEISM....
```

and BELIEVING-SYSTEM of ENGLAND is MONOTHEISM....

therefore an analogy of BELIEVING-SYSTEM between FRANCE and ENGLAND.

*** End of analysis third-level-analysis ?

aspect-of-monotheism

*** FRANCE and ENGLAND have the same ASPECT-OF-MONOTHEISM

which is UNIQUE-GOD therefore an analogy of

ASPECT-OF-MONOTHEISM between FRANCE and ENGLAND.

As we see here, with the nested frames, and with the successive shells of knowledge, we can go further in our analysis. We are not stopped at the first level if the two domains are not analogous on that precise level of goal and meaning identification.

In the previous example, there was no analogy of religions between France and England. But, as we go further in the analysis of the domains, we notice that though both countries are not analogous in regard to religion, their religions both have the same *believing system* which is monotheism. On one further level of analysis, the *aspect-of-monotheism*, we find the same concept of *uniqueness-of God*.

Therefore, on the second and third levels of analysis between France and England, they are analogous regarding the concept of *uniqueness-of God*. However, at the beginning of the analysis in regard to religion, the countries were not analogous.

This example shows clearly the concept of structural analysis and the meaning of the meaning and the level of the analogy described in Chapter 1.

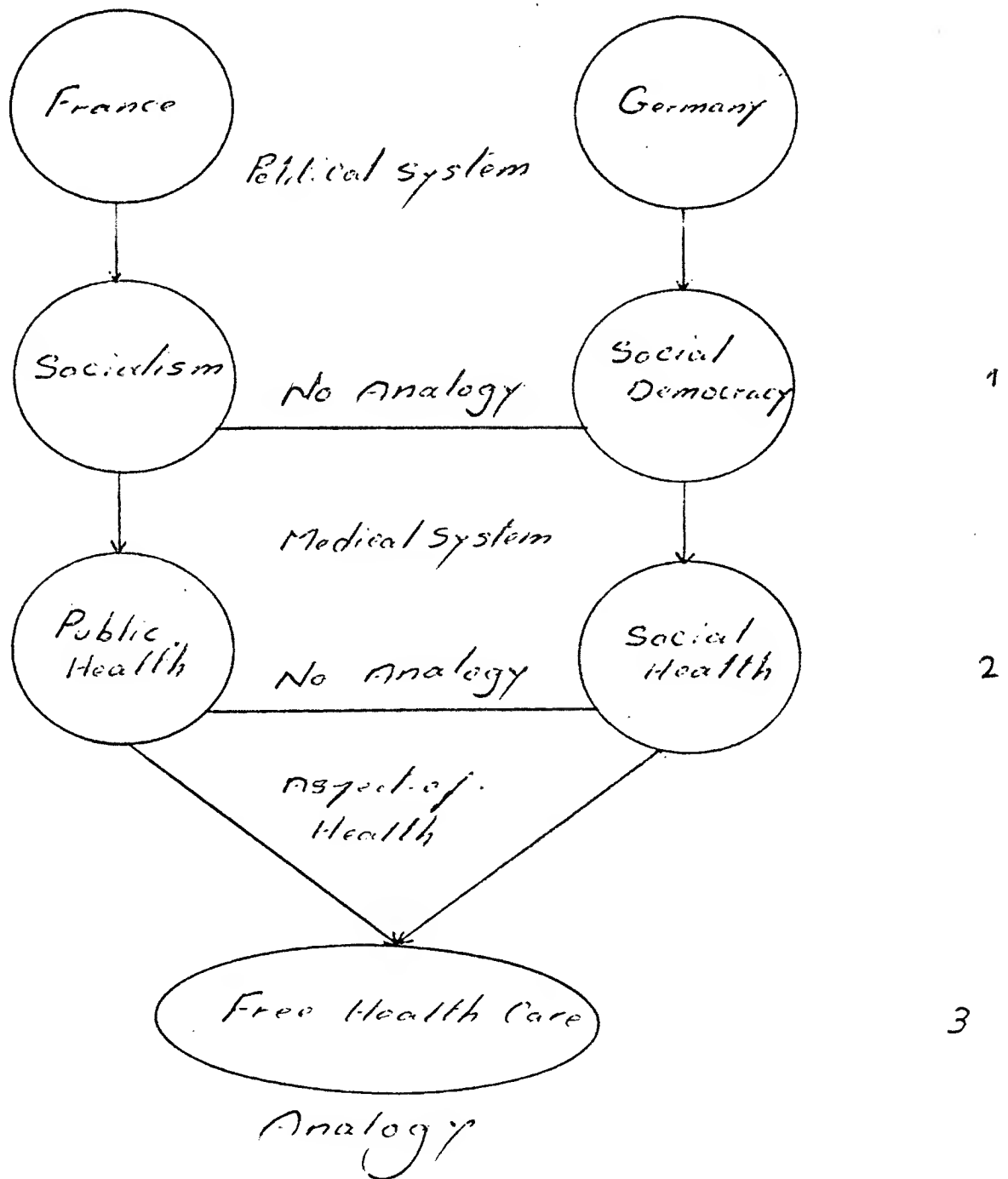
Refer to page 12 and 13 for diagram of Semantic Network.

More experiments concerning this concept can be found in Appendix.

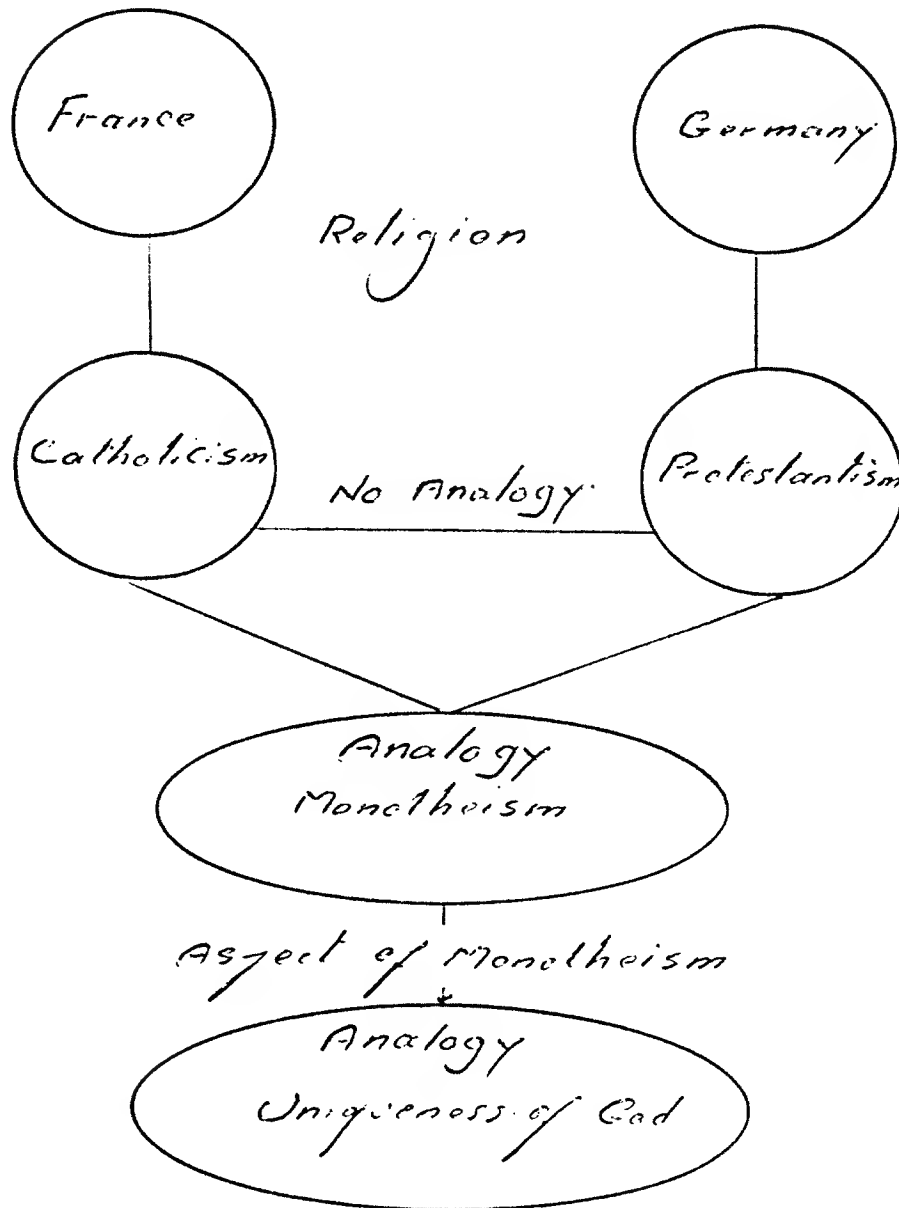
2.3. A Particular Form of knowledge-acquisition and Problem Solving; Frames as the Final Representation of Knowledge

As we will see in detail, the final results at the end of the stage of knowledge-acquisition or automatic-acquisition or problem solving is the frame whose name becomes the learning or problem solving theme. Here, we will first talk about learning, and then about the particular case of problem solving.

Semantic Network for an Analogy in
Third Level



Semantic Network for an Analogy
in Second and third level



1

2

3

2.3.1. Knowledge-Acquisition

Let us first look at, in the case of structural analogy, what we call knowledge-acquisition: the knowledge-acquisition mechanism for one new domain from the others is activated during each analogical comparison or matching on one level or an identification on several levels.

Whatever it is, the result of this identification, the selection from a collection of domains corresponding to the same level of structural analysis and analogy, named by the meaning and level of analysis is considered as a summation of information which determines the knowledge acquired about the domain. This knowledge, acquired or learned, is presented in the final stage in the form of frames.

In implementation, the learning stage is activated from the start of the matching between the two domains, and every matching creates a new slot for the frame of knowledge-acquisition whose name is the meaning, or goal of the level of analysis of the analogy. We should add that, the frames generated as the consequence of learning, are independent from the matching result of the analogy and the appropriate message which follows that.

Therefore, in this sort of analogy, for the frame of knowledge-acquisition for the *European military treaty* we obtain after having established a correspondence between France and England and on the other hand, between Germany and Poland, the following frames:

```
(f european-military-treaty)
(EUROPEAN-MILITARY-TREATY (NEUTER (FRANCE))
                             (NATO (ENGLAND) (GERMANY))
                             (WARSAW (POLAND)))
```

and for *universities*, the following frame:

```
(f university)
(UNIVERSITY (PARIS-ORSAY (FRANCE))
             (IMPERIAL-COLLEGE (ENGLAND))
             (TECHNICAL-SCHOOL (GERMANY))
             (POLYTECHNIC-OF-WARSAW (POLAND)))
```

Of course, here we could have inverted the order of the correspondence between the above countries, for example, France with Germany and England with Poland, but the final result, which would be the frame generation for *European military treaty* and *universities*, concerning the knowledge acquisition would be absolutely the same.

It is emphasized that, in the original knowledge based system we did not have a direct knowledge about the universities of the European countries. The frame shown above is the result of what we call structural analogy.

2.3.2. Automatic-Acquisition

This is the most important part of knowledge acquisition in reasoning by structural analogy. As we saw previously by the use of nested frames we can describe the successive shells of knowledge when going further in analysis and reasoning about a domain.

From the beginning of analysis and because of the nested form of representation of knowledge, we can not see and determine the right information.

This interdependence of knowledge and information means that without a hierarchy and structure we can not recognize the precise knowledge, thereby a knowledge acquisition and learning about a domain would be extremely difficult.

The system "MULTI-ANALOG", is able to process an automatic-acquisition of knowledge and learning. That means, in the case of the European countries it is able to go through the multiple shells of knowledge and by the appropriate final frames describe the knowledge about every country.

(automatic-acquisition)

*** Goal

medical-system

*** It is done

(f MEDICAL-SYSTEM)

(MEDICAL-SYSTEM (PUBLIC-HEALTH (FRANCE))
 (SOCIAL-HEALTH (GERMANY))
 (NATIONAL-HEALTH (ENGLAND))
 (POPULAR-HEALTH (POLAND)))

Another example:

(automatic-acquisition)

*** Goal

aspect-of-military

*** It is done

(f aspect-of-military)
(ASPECT-OF-MILITARY (NEUTER (FRANCE))
 (NATO (GERMANY))
 (NATO (ENGLAND))
 (COMMECON (POLAND)))

Creation of these frames is something new for the system. That means, in the initial knowledge based system, this information was not explicitly described and we did not have a clear idea about this knowledge.

In addition the system is able to do automatic research and to create automatically a new frame with the new findings and organisation.

2.3.3. Matching Concept

The problems are presented in a particular form of natural language. With a parser (Boris Katz, 1980) we can translate English description of situations into internal semantic network.

The text contains a series of sentences that can be translated into frame form with slots and value slots, processable by a particular form of FRL, Frame Representation Language [Roberts and Goldstein, 1977], realized by P.H. Winston [Learning and Reasoning by Analogy, May 1980].

Each sentence will be considered like a frame with or without slots and value slots.

So that each sentence is acceptable, it must correspond to a previous structural analogy, which means that a form of knowledge-acquisition has already occurred.

With each structural analogy, a whole series of sentences in the form of:

(fputv 'x 'aspect-of-health 'free-health-care)
(*information belonging to learning*)

had already been created by the system "MULTI-ANALOG".

It means, in this particular case, that the country's *aspect-of-health* is AKO *free-health-care*.

We should notice that X, *aspect-of-health* and *free-health-care* in the initial representation of knowledge, correspond to different levels of nested frames.

We must emphasize that it is the matching and the aspect of structural identification for knowledge-acquisition that allowed the creation of this new form of frame, with the association between the elements which previously did not exist.

Thus, the interface of all the sentences, generated in the form of frames, belonging to the initial text, containing a single subject to be found, becomes a kind of solution.

Example:

The type of text and the problem that we could have such as:

* X is a country. Its religion is Protestantism. Its medical- system is national- health. X has a military- system aligned. Its aspect-of-military is NATO. Its educational- system is a constitutional-rights. X has a AKO- Democracy for political- system. Its museum is British- museum. X has Imperial- College for a university.

*** Problem to solve ? (y or n) y (yes)

*** A certain kind...of..problem!!

```
(fputv 'x 'university 'imperial-college)
(fputv 'x 'museum 'british-museum)
(fputv 'x 'political-system 'ako-democracy)
(fputv 'x 'educational-system 'constitutional-rights)
(fputv 'x 'military-system 'aligned)
(fputv 'x 'aspecct-of-military 'nato)
(fputv 'x 'medical-system 'national-health)
(fputv 'x 'religion 'protestant)
```

*** there's a solution and that's ENGLAND

*** A new problem ? (y or n)

In order to have a global solution, all the sentences presented in semantic network must already have had an antecedent and the appropriate frame must already have been built.

This means that a knowledge-acquisition with "MULTI-ANALOG", in "simple-analog" or "compound-analog" or "automatic-acquisition" for the frame, slot and value slot had already occurred.

If this is not the case, "MULTI-ANALOG" shows us, for each unknown semantic representation, that a corresponding learning should have already taken place.

For the other sentences, the system tries to find the unknown common subject in all of the representations.

As in the following example :

The text of the example is:

* X is a country. Its history is old. X has ako-democracy for political-system. Its aspect-of-military is NATO. X has a national-health for medical-system. Its religion is protestantism.

*** A new problem ? (y or n) y (yes)

*** A certain kind...of..problem!!

```
(fputv 'x 'religion 'protestantism)
(fputv 'x 'medical-system 'national-health)
(fputv 'x 'aspect-of-military 'nato)
(fputv 'x 'political-system 'ako-democracy)
(fputv 'x 'history 'old)
```

*** Attention the system knows nothing about old for history. It should first learn it.

*** There's a solution and that's ENGLAND

*** A new problem ? (y or n)

As we see here, "MULTI-ANALOG" knows nothing about *old* for *history*. This means that the stage of knowledge-acquisition *old* for *history* did not occur. For the other aspect of the problem, the system finds England as an answer to the problem.

We can deduce from this, that there can be no problem solving if the learning has not already taken place.

3. Conclusion

Within this paper I tried to show that the concept of reasoning by structural analogy is possible. Furthermore, an implemented system "MULTI-ANALOG" is presented which discusses a limited example of knowledge-acquisition, problem solving and automatic-acquisition of knowledge.

In this first paper, our possibilities for implementation were limited by the nested frames within only three levels. The next step would be to go as far as possible on the levels of the frames in order to have a better and deeper degree of analysis and knowledge-acquisition by analogy.

Regarding problem solving, for the moment, we are limited to the text and the sentences such as *X is a country, Its political system is Democracy*, etc.

A better approach to the most complicated sentences should be taken using a more powerful parser to generate a more complex semantic network in the form of frames, which would permit us to resolve the problems with a more sophisticated syntax.

One important feature of the system "MULTI-ANALOG", is the stage of automatic-acquisition which permits, in the case of nested frames, the creation of new frames, with the new structures. These new frames are the frames of knowledge acquisition or learning which are created in an automatic way without going through the stage of step by step reasoning by analogy.

4. Appendix Experiments

Here, we give a general example of processing by "MULTI-ANALOG", starting with reasoning by structural analogy, then knowledge acquisition and finally, problem solving.

Nested Frames concerning France

```
(f france)
(FRANCE (CAPITAL (PARIS))
        (POLITICAL-SYSTEM (AKO-SOCIALISM))
        (RELIGION (CATHOLICISM)))
```

```
(f paris)
(PARIS (UNIVERSITY (PARIS-ORSAY))
       (MUSEUM (RODIN)))
```

```
(f ako-socialism)
(AKO-SOCIALISM (EDUCATIONAL-SYSTEM (PUBLIC-EDUCATION))
               (MILITARY-SYSTEM (INDEPENDENT))
               (MEDICAL-SYSTEM (PUBLIC-HEALTH)))
```

```
(f catholicism)
(CATHOLICISM (BELIEVING-SYSTEM (MONOTHEISM)))
```

```
(f paris-orsay)
(PARIS-ORSAY (FIELD-OF-STUDY (SCIENCE)))
```

```
(f rodin)
(RODIN (MOST-ARTISTIC-ACTIVITIES (SCULPTURE)))
```

```
(f public-education)
(PUBLIC-EDUCATION (ASPECT-OF-EDUCATION (FREE-EDUCATION)))
```

```
(f independent)
(INDEPENDENT (ASPECT-OF-MILITARY (NEUTER)))
```

```
(f public-health)
(PUBLIC-HEALTH (ASPECT-OF-HEALTH (FREE-HEALTH-CARE)))
```

```
(f monotheism)
(MONOTHEISM (ASPECT-OF-MONOTHEISM (UNIQUENESS-OF-GOD)))
```

Nested Frames concerning England

(f england)
(F ENGLAND (CAPITAL (LONDON))
 (POLITICAL-SYSTEM (AKO-DEMOCRACY))
 (RELIGION (PROTESTANTISM)))

(f london)
(LONDON (UNIVERSITY (IMPERIAL-COLLEGE))
 (MUSEUM (BRITISH-MUSEUM)))

(f ako-socialism)
(AKO-SOCIALISM (EDUCATIONAL-SYSTEM (CONSTITUTIONAL-RIGHTS))
 (MILITARY-SYSTEM (ALIGNED))
 (MEDICAL-SYSTEM (NATIONAL-HEALTH)))

(f protestantism)
(PROTESTANT (BELIEVING-SYSTEM (MONOTHEISM)))

(f imperial-college)
(IMPERIAL-COLLEGE (FIELD-OF-STUDY (SCIENCE)))

(f british-museum)
(BRITISH-MUSEUM (MOST-ARTISTIC-ACTIVITIES (PAINTING)))

(f constitutional-rights)
(CONSTITUTIONAL-RIGHTS (ASPECT-OF-EDUCATION (FREE-EDUCATION)))

(f aligned)
(ALIGNED (ASPECT-OF-MILITARY (NATO)))

(f national-health)
(NATIONAL-HEALTH (ASPECT-OF-HEALTH (FREE-HEALTH-CARE)))

(f monotheism)
(MONOTHEISM (ASPECT-OF-MONOTHEISM (UNIQUENESS-OF-GOD)))

Beginning of the stage of reasoning by structural analogy and knowledge-acquisition

The case of simple Analogy

(multi-analog)

simple-analog

*** READY

(simple-analog 'france 'england)

*** GOAL

position-second-world-war

*** POSITION-SECOND-WORLD-WAR of FRANCE is allied and
POSITION-SECOND-WORLD-WAR of ENGLAND is allied therefore an
analogy of POSITION-SECOND-WORLD-WAR between FRANCE and ENGLAND.

(simple-analog 'germany 'poland)

*** Goal

position-second-world-war

*** POSITION-SECOND-WORLD-WAR of germany is AXIS and
POSITION-SECOND-WORLD-WAR of POLOGNE is NEUTER ..therefore no
analogy of POSITION-SECOND-WORLD-WAR between GERMANY and
POLOGNE.

Those analogical reasoning create the following frame:

```
(f position-second-world-war)
(PPOSITION-SECOND-WORLD-WAR (ALLIED (FRANCE))
                              (ALLIED (ENGLAND))
                              (AXIS (GERMANY))
                              (NEUTER (POLOGNE)))
```

The case of compound analogy

(multi-analog)

(compound-analog)

*** READY

(compound-analog 'france 'england)

*** beginning of analysis first-level-analysis ?

political-system

*** POLITICAL-SYSTEM of FRANCE is AKO-SOCIALISM and
POLITICAL-SYSTEM of ENGLAND is AKO-DEMOCRACY...therefore no analogy
of POLITICAL-SYSTEM between FRANCE and ENGLAND.

*** suite of analysis second-level-analysis ?

educational-system

*** EDUCATIONAL-SYSTEM of FRANCE is PUBLIC-EDUCATION and
EDUCATIONAL-SYSTEM of ENGLAND is CONSTITUTIONAL-RIGHTS...therefore
no analogy of EDUCATIONAL-SYSTEM between FRANCE and ENGLAND.

*** end of analysis third-level-analysis ?

aspect-of-education

*** FRANCE and ENGLAND have the same ASPECT-OF-EDUCATION which is
FREE-EDUCATION therefore an analogy of ASPECT-OF-EDUCATION between
FRANCE and ENGLAND.

We continue the same processing for germany and poland regarding

political-system, educational-system, and aspect-of-education. Finally we obtain the following frames:

```
(f political-system)
(POLITICAL-SYSTEM (AKO-SOCIALISM (FRANCE))
                  (AKO-DEMOCRACY (ENGLAND))
                  (SOCIAL-DEMOCRACY (GERMANY))
                  (COMMUNISM (POLAND)))
```

```
(f educational-system)
(EDUCATIONAL-SYSTEM (PUBLIC-EDUCATION (FRANCE))
                   (CONSTITUTIONAL-RIGHTS (ENGLAND))
                   (CONSTITUTIONAL-RIGHTS (GERMANY))
                   (CONSTITUTIONAL-RIGHTS (POLAND)))
```

```
(f aspect-of-education)
(ASPECT-OF-EDUCATION (FREE-EDUCATION (FRANCE))
                    (FREE-EDUCATION (ENGLAND))
                    (FREE-EDUCATION (GERMANY))
                    (FREE-EDUCATION (POLAND)))
```

Therefore, new relations and frames are created which did not exist in the initial knowledge based system and which create some new explicit knowledge about each country.

The case of problem solving

(multi-analog)

*** READY

After the stage of knowledge-acquisition.

*** Problem to solve ? (y or n) y (yes)

*** A certain kind...of..problem!!

(fputv 'x 'museum 'rodin)
(fputv 'x 'most-artistic-activities 'sculpture)
(fputv 'x 'political-system 'ako-socialism)
(fputv 'x 'educational-system 'public-education)
(fputv 'x 'aspect-of-education 'free-education)

*** there's a solution and that's FRANCE

*** A new problem ? (y or n) y (yes)

*** A certain kind...of..problem!!

(fputv 'x 'museum 'british-museum)
(fputv 'x 'most-artistic-activities 'painting)
(fputv 'x 'political-system 'ako-democracy)
(fputv 'x 'educational-system 'constitutional-rights)
(fputv 'x 'aspect-of-education 'free-education)

*** there's a solution and that's ENGLAND

*** A new problem ? (y or n) no

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